WHAT IS CLAIMED IS:

1. A plasma processing method comprising:

introducing a gas into a vacuum chamber through a hole of a dielectric tube attached to a metal body fixed to the vacuum chamber while exhausting from the vacuum chamber to keep the vacuum chamber within a specified pressure; and

applying high-frequency power with a frequency ranging from 100kHz to 3GHz to a plasma source provided so as to face a substrate mounted on a substrate electrode in the vacuum chamber to generate plasmas in the vacuum chamber to perform plasma processing of the substrate.

2. A plasma processing method as defined in Claim 1, wherein the high-frequency power is applied to an antenna serving as the plasma source through a penetrating hole given near a center of the dielectric plate with the antenna and the vacuum chamber short-circuited with short pins through penetrating holes which are given at an area located not in a center nor a vicinity of the dielectric plate and which are disposed at approximately equal intervals around a center of the antenna.

3. A plasma processing method as defined in Claim 1, wherein a substrate is processed in a state that a plasma distribution on the substrate is controlled by a circular and groove shaped plasma trap provided between the antenna and the vacuum chamber.

4. A plasma processing method as defined in Claim 1, wherein a substrate is processed in a state that a plasma distribution on the substrate is controlled by a groove shaped plasma trap provided between the antenna and the metal body which is a ring disposed so as to constitute the plasma trap therebetween.

5. A plasma processing method comprising:

introducing a gas into a vacuum chamber through a hole of a dielectric tube attached to a facing electrode provided so as to face a substrate electrode in the vacuum chamber while exhausting from the vacuum chamber to keep the vacuum chamber within a specified pressure; and

applying high-frequency power with a frequency ranging from 100kHz to 3GHz to the substrate electrode or the facing electrode to generate plasmas in the vacuum chamber to perform plasma processing of the substrate.

6. A plasma processing method as defined in Claim 1, wherein gas supply flow rate per hole given to the dielectric tube is 200sccm or less.

7. A plasma processing method as defined in Claim 1, wherein gas supply flow rate per hole given to the dielectric tube is 50sccm or less.

8. A plasma processing method as defined in Claim 1, wherein the gas is a mixed gas mainly composed of an argon gas.

9. A plasma processing method as defined in Claim 1, wherein pressure in the vacuum chamber is 10Pa or less.

10. A plasma processing method as defined in Claim 1, wherein pressure in the vacuum chamber is 1Pa or less.

11. A plasma processing method as defined in Claim 1, wherein a frequency of the high-frequency power applied to the plasma source, the substrate electrode or the facing electrode is 50MHz to 3GHz.

12. A plasma processing method as defined in Claim 6, wherein gas supply flow rate per hole given to the dielectric tube is 200sccm or less.

13. A plasma processing method as defined in Claim 6, wherein gas supply flow rate per hole given to the dielectric tube is 50sccm or less.

14. A plasma processing method as defined in Claim 6, wherein the gas is a mixed gas mainly composed of an argon gas.

15. A plasma processing method as defined in Claim 6, wherein pressure in the vacuum chamber is 10Pa or less.

16. A plasma processing method as defined in Claim 6, wherein pressure in the vacuum chamber is 1Pa or less.

17. A plasma processing method as defined in Claim 6, wherein a frequency of the high-frequency power applied to the plasma source, the substrate electrode or the facing electrode is 50MHz to 3GHz.

18. A plasma processing apparatus comprising:

a vacuum chamber capable of maintaining a vacuum state;

a gas supply device for supplying a gas into the vacuum chamber;

an exhauster for exhausting the gas from the vacuum chamber;

a substrate electrode for mounting a substrate in the vacuum chamber;

a plasma source provided so as to face the substrate electrode;

a high-frequency power source for supplying high-frequency power with a frequency ranging from 100kHz to 3GHz to the plasma source; and

a dielectric tube having a gas supply hole, attached to a metal body fixed to the vacuum chamber, for passing the gas through the gas supply hole thereof when the gas is supplied to the vacuum chamber by the gas supply device.

19. A plasma processing apparatus as defined in Claim 18, wherein a dielectric plate is interposed between the vacuum chamber and an antenna serving as the plasma source, and the antenna and the dielectric plate are protruded in the vacuum chamber.

20. A plasma processing apparatus as defined in Claim

19, wherein high-frequency power is supplied to the antenna through a penetrating hole given near a center of the dielectric plate, and the antenna and the vacuum chamber are short-circuited with short pins through penetrating holes which are given at an area located not in a center nor a vicinity of the dielectric plate and which are disposed at approximately equal intervals around a center of the antenna.

21. A plasma processing apparatus as defined in Claim 19, wherein a substrate is processed in a state that a plasma distribution on the substrate is controlled by a circular and groove shaped plasma trap provided between the antenna and the vacuum chamber.

22. A plasma processing apparatus as defined in Claim 18, wherein the metal body is a ring that constitutes a part of a side wall of the vacuum chamber.

23. A plasma processing apparatus as defined in Claim 21, wherein the metal body is a ring disposed so as to constitute a plasma trap between the metal body and the antenna.

24. A plasma processing apparatus comprising:

a vacuum chamber capable of maintaining a vacuum state;

a gas supply device for supplying a gas into the vacuum chamber;

an exhauster for exhausting the gas from the vacuum chamber;

a substrate electrode for mounting a substrate in the vacuum chamber;

a facing electrode provided so as to face the substrate electrode;

a high-frequency power source for supplying high-frequency power with a frequency ranging from 100kHz to 3GHz to the substrate electrode or the facing electrode;

a dielectric tube having a gas supply hole, attached to a metal body fixed to the facing electrode, for passing the gas through the gas supply hole thereof when the gas is supplied to the vacuum chamber by the gas supply device.

25. A plasma processing apparatus as defined in Claim 18, wherein the dielectric tube is a bolt screwed in a tap given to the metal body or the facing electrode.

26. A plasma processing apparatus as defined in Claim 18, wherein the dielectric tube has a spot facing for screwdriver or wrench on a side of an inner wall of the vacuum chamber for rotating and screwing the dielectric tube in the metal plate or the facing electrode.

27. A plasma processing apparatus as defined in Claim 18, wherein the dielectric tube is protruded by 0.5 to 20mm from a surface of the metal body or the facing electrode.

28. A plasma processing apparatus as defined in Claim 18, wherein the dielectric tube is protruded by 1 to 10mm from a surface of the metal body or the facing electrode.

29. A plasma processing apparatus as defined in Claim 27 or 28, wherein the dielectric tube is disposed such that it covers an edge of a hole of the metal body or the facing electrode.

30. A plasma processing apparatus as defined in Claim 18, wherein the hole of the dielectric tube is 0.2 to 2mm in diameter.

31. A plasma processing apparatus as defined in Claim 18, wherein the hole of the dielectric tube is 0.4 to 0.8mm in diameter.

32. A plasma processing apparatus as defined in Claim 18, wherein a frequency of high-frequency power applied to the plasma source, the substrate electrode or the facing electrode is 50MHz to 3GHz.

33. A plasma processing apparatus as defined in Claim 24, wherein the dielectric tube is a bolt screwed in a tap given to the metal body or the facing electrode.

34. A plasma processing apparatus as defined in Claim 24, wherein the dielectric tube has a spot facing for screwdriver or wrench on a side of an inner wall of the vacuum chamber for rotating and screwing the dielectric tube in the metal plate or the facing electrode.

35. A plasma processing apparatus as defined in Claim 24, wherein the dielectric tube is protruded by 0.5 to 20mm from a surface of the metal body or the facing electrode.

36. A plasma processing apparatus as defined in Claim 24, wherein the dielectric tube is protruded by 1 to 10mm from a surface of the metal body or the facing electrode.

37. A plasma processing apparatus as defined in Claim 27 or 28, wherein the dielectric tube is disposed such that it covers an edge of a hole of the metal body or the facing electrode.

38. A plasma processing apparatus as defined in Claim 24, wherein the hole of the dielectric tube is 0.2 to 2mm in diameter.

39. A plasma processing apparatus as defined in Claim 24, wherein the hole of the dielectric tube is 0.4 to 0.8mm in diameter.

40. A plasma processing apparatus as defined in Claim 24, wherein a frequency of high-frequency power applied to the plasma source, the substrate electrode or the facing electrode is 50MHz to 3GHz.